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SYNOPSIS: The pumping sump for the Petacalco, Gro. Power Plant required for its construction an excavation 100 x 87 m plan and 11 m depth. The calculated flow towards the excavation was 370 ℓ/s. Two perimetral systems were proposed to control the inflow water: Cut-off wall or conventional pumping system. After a technical-economical analysis, the first one was selected. Due to construction delays of the cut-off wall and program construction demands, the excavation began simultaneously and advanced faster than the wall. The observed inflow water was ten times lesser than the predicted one, so that the construction of the wall was suspended. The excavation finished using a 6" diameter pump working continuously with a 35 ℓ/s flow. During the excavation randomly thin layers and pockets of peat and organic clay were observed. These materiales were not detected in the geotechnical exploration. The flow reduction is attributed to the presence of those materials.

INTRODUCTION

The Petacalco Power Plant is located in the western coast of Mexico (fig 1). Geologically the zone corresponds to the ancient deltaic area of the Balsas River (Mooser, 1986), whose deposits are constituted of conglomerates, alluvial soils, sands and fine soils of high shear strength. The seismic activity in this zone is the most important in Mexico.

This paper deals with the pumping sump excavation for units 1 to 4.

PUMPING SUMP DESCRIPTION

Fig 2 shows the layout of the Power Plant and the ubication of the pumping sump.

The structure consists basically in a water-tight caisson of reinforced concrete 49 x 34 m plan and 12.5 m height with a depth foundation of 11 m. Geometry and dimensions are shown in fig 3.

The pumping sump required for its construction an excavation 100 x 87 m plan and 11 m depth, this one had to be dry for a period of one year.

GEOTECHNICAL EXPLORATION

The site was previously studied and geotechnically characterized, so that it was proceeded to make just four verification soundings to a maximum depth of 50 m. In the borings permeability tests were made each meter depth. Additionally two pumping tests were carried out for enhance the information. Fig 4 shows the layout of the borings, pumping tests and piezometers for monitoring the lowering of the water level.

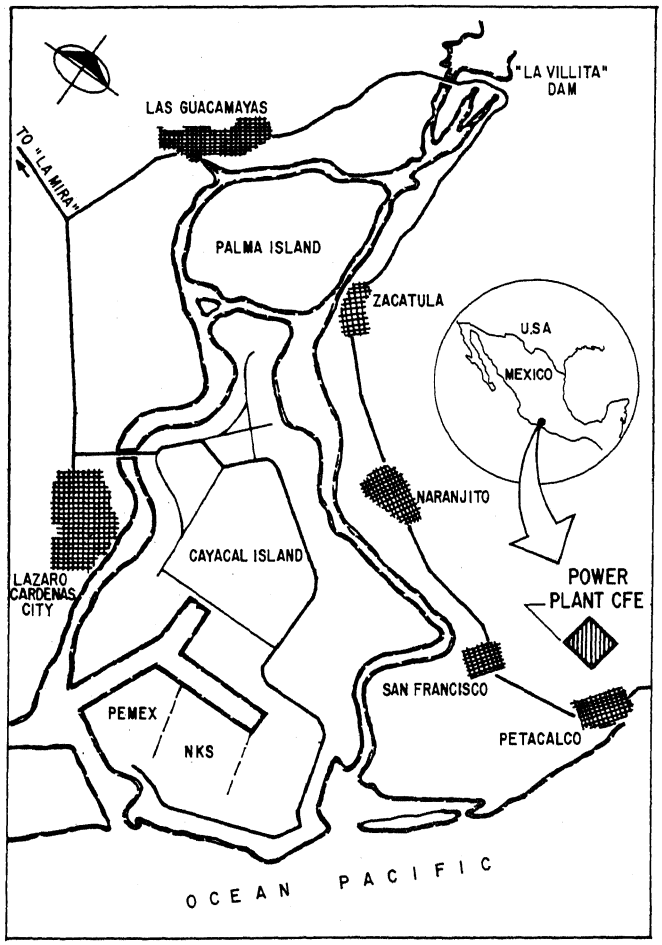


Fig 1 Localization of the Power Plant

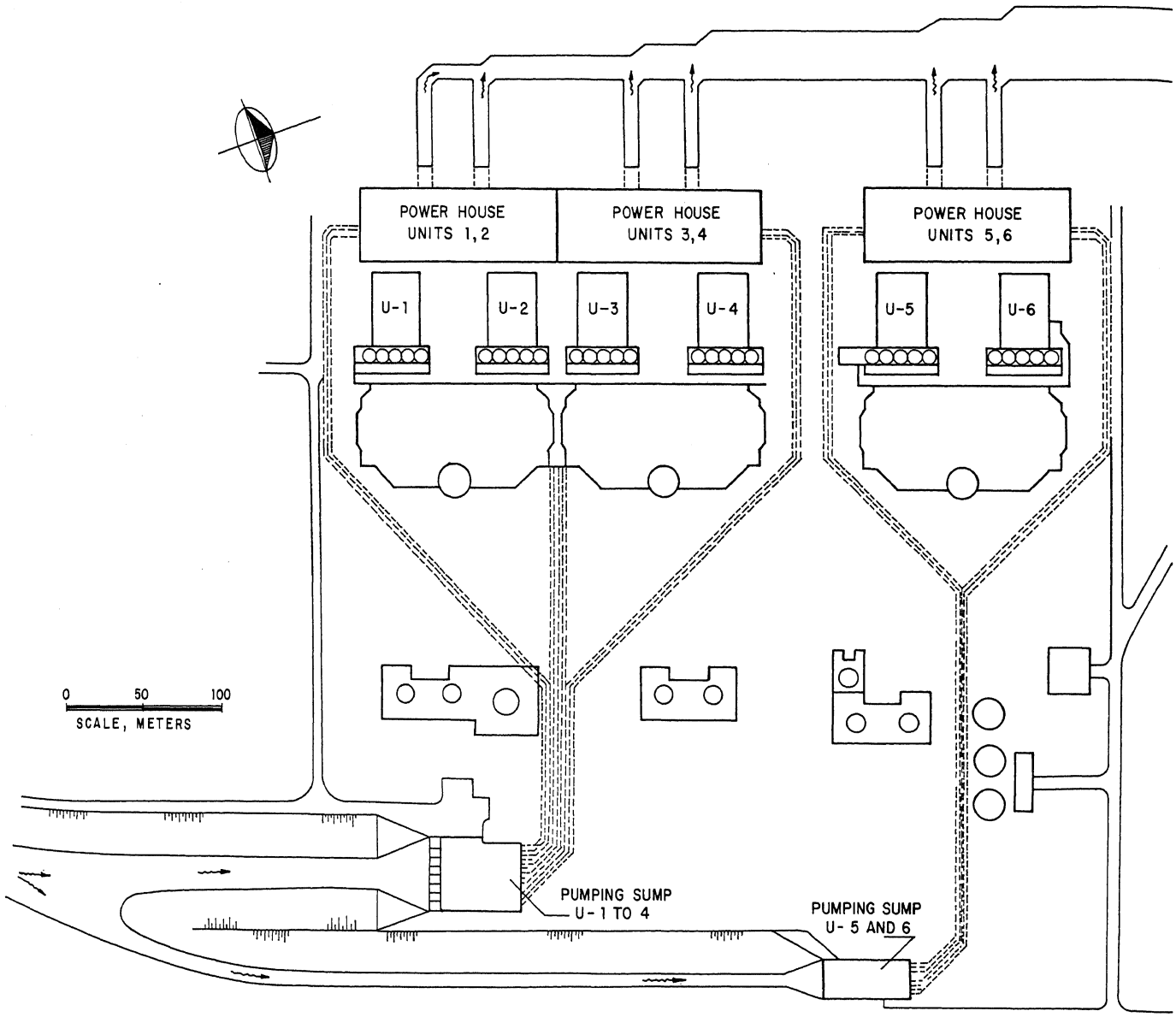


Fig. 2 Power Plant Layout.

SUBSOIL ESTRATIGRAPHY

It was found five main deposits. The upper one a gravelly-sand layer of 9 to 16 m thick, underlayed by fine soils (clays CH and silts MH) interbedded with granular soil deposits. The water level was found 2 m depth. Figs 5 and 6 show a typical subsoil profile and a cross-section.

ANALYSIS

The pumping tests were made in deposits 1 and 3. Table 1 shows the results from the permeability tests and pumping tests, it can be seen that both results are basically the same. The flow towards the excavation was calculated in 370 ℓ/s, then two perimetral systems were proposed to handle it.

a) Cut-off wall embedded in deposit 2

b) Conventional pumping system.

After a technical-economical analysis the cut-off wall was chosen.

OBSERVED BEHAVIOUR

The original construction procedure contemplated the following main steps.

a) Cut-off wall construction

b) Dewatering the water table inside the excavation zone

c) Excavation

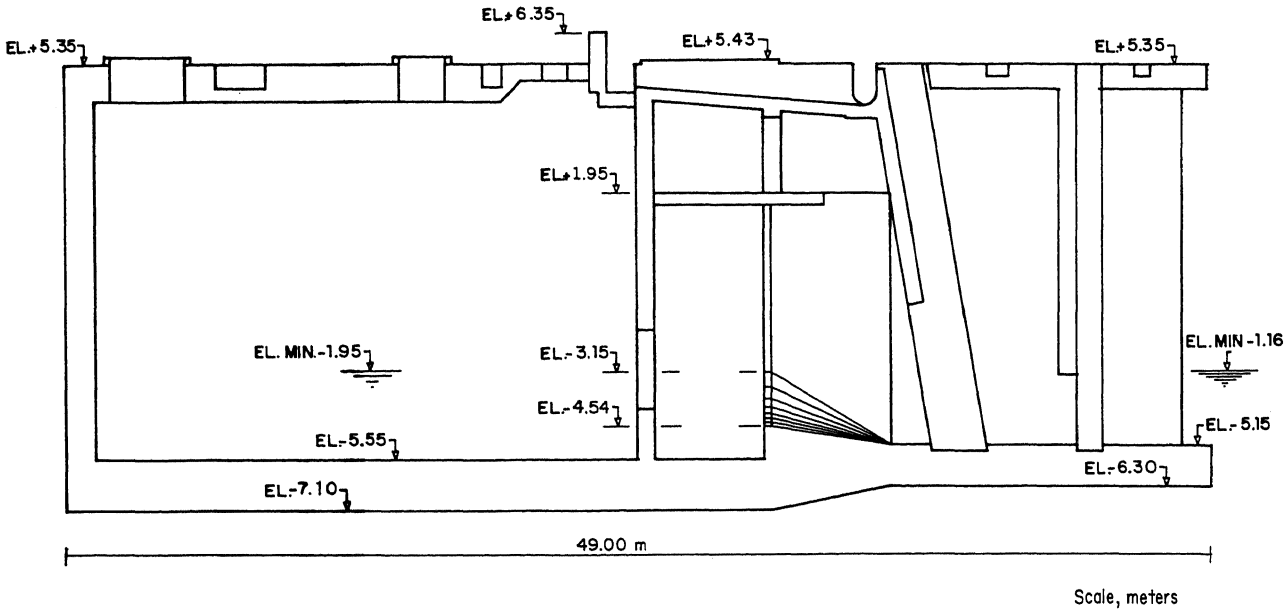


Fig. 3 Longitudinal section of the Pumping Sump

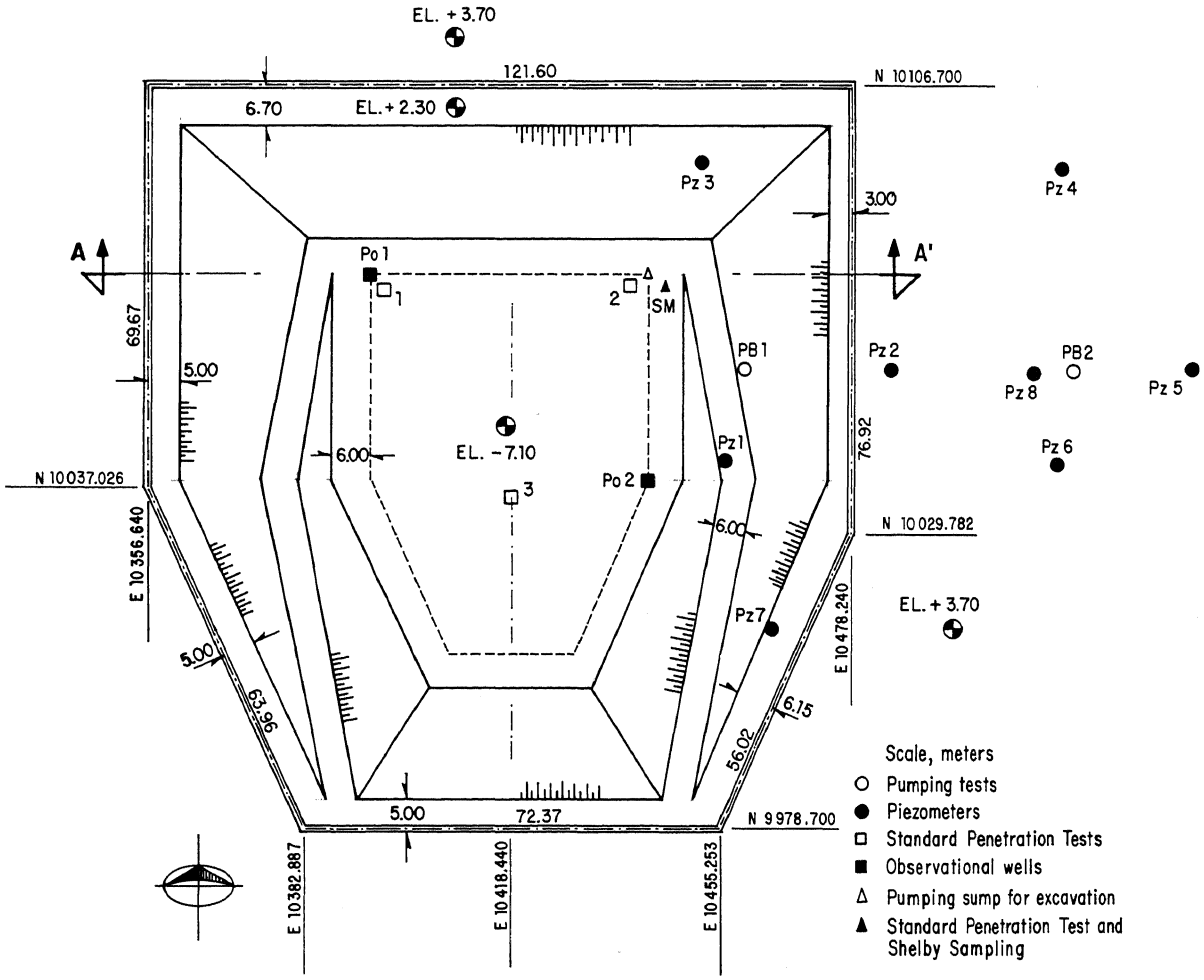
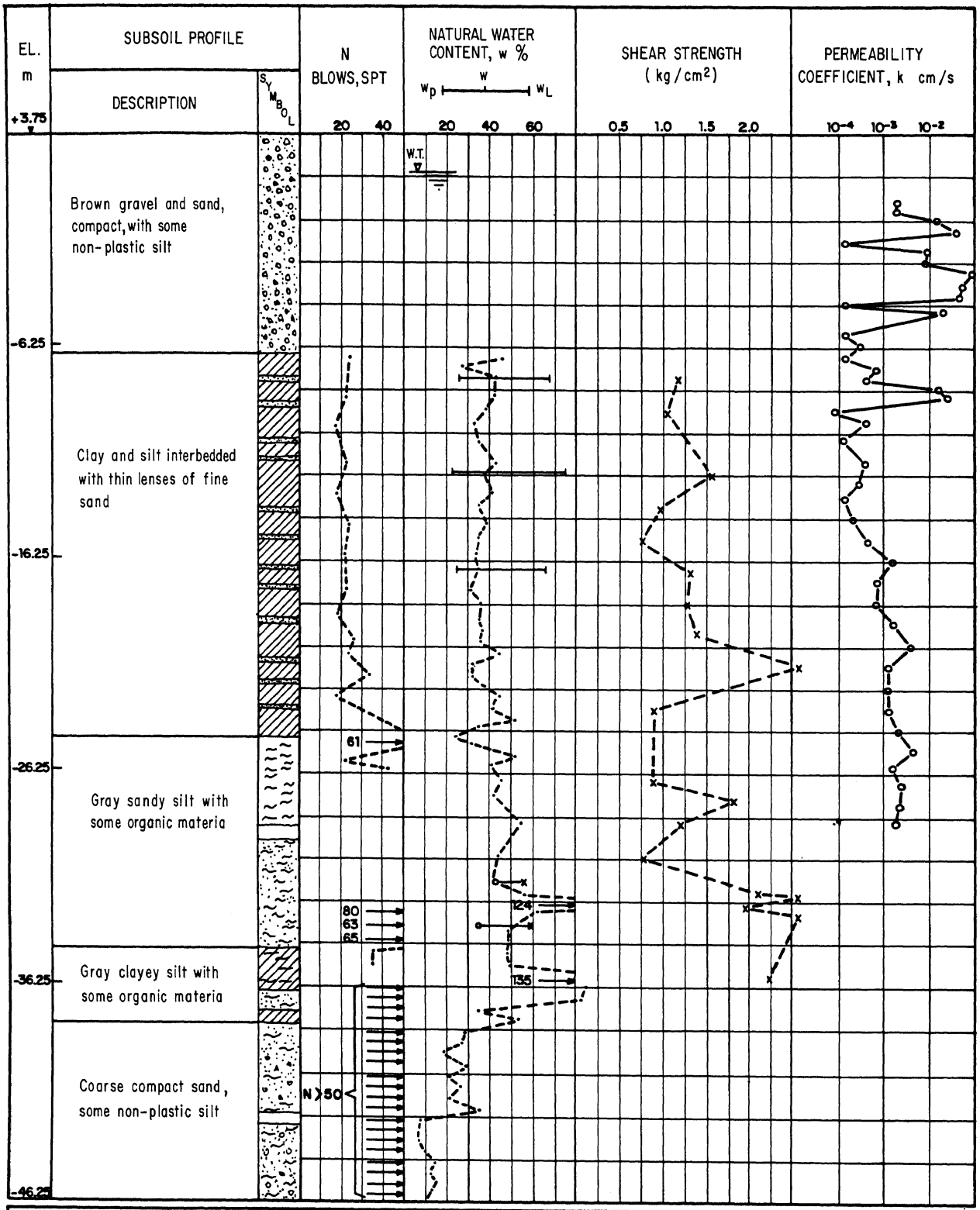


Fig 4 Localization of borings, pumping tests, observational wells and piezometers



CLAY
SILT
SAND
GRAVEL

W.T. WATER TABLE

NOTES: "HW" CASING

BORING TOOLS: CONE ROCK BIT

COMISION FEDERAL DE ELECTRICIDAD

SUBDIRECCION TECNICA
GERENCIA DE INGENIERIA EXPERIMENTAL Y CONTROL

PROJECT:
PUMPING SUMP U. 1-4, PETACALCO, GRO.

BORING: SM-3	DATE: MAY-1989
ELEVATION +3.75 m	FIG. 5

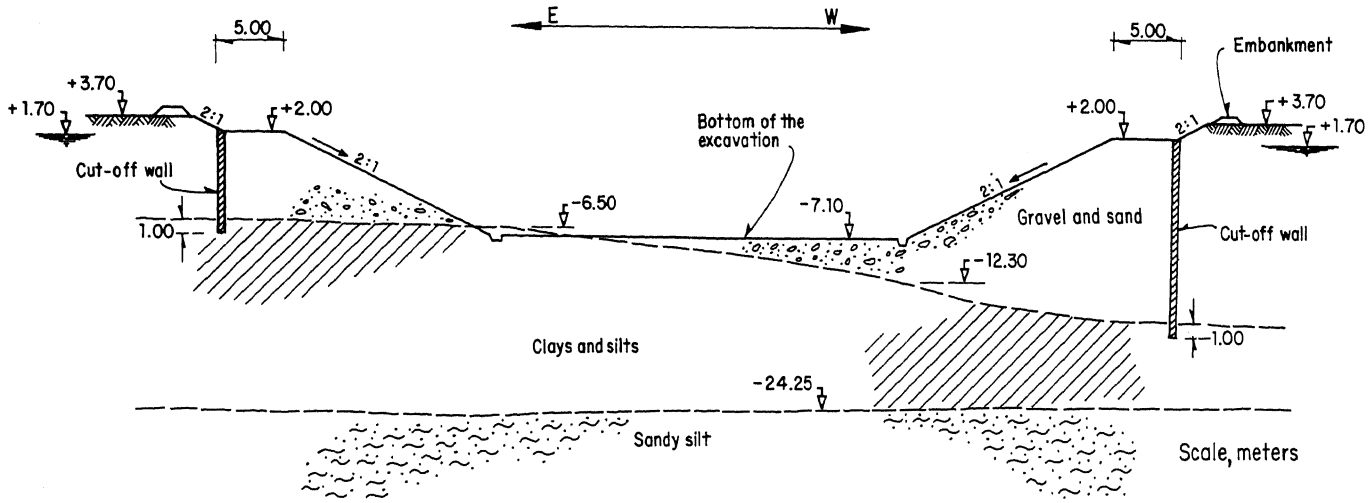


Fig. 6 Cross Section A-A

TABLE 1

Permeability coefficients of the subsoil deposits located in the pumping sump area

Deposit	Pumping test	Permeability coefficients in cm/s	
		Pumping test	Permeability tests
1	1	6.2×10^{-2}	2.4×10^{-2}
3	2	6.2×10^{-3}	4.8×10^{-3}

Due to construction delays of the cut-off wall and program demands, the excavation began simultaneously and advanced faster than the wall. An emergency pumping system was installed and the water level was controlled with a 6" diameter pump. The pumping system is shown in fig 4.

Fig 7 shows the water levels in piezometers and observational wells, where it can be seen that even when excavation reached the final depth (el. -7.10 m) and with the cut-off wall unfinished, the water level was always 0.8 m beneath the floor. Due to this fact the cut-off wall was suspended with a construction stage as shown in fig 8.

The pumping sump was constructed with only one 6" diameter pump operating continuously with a flow of 35 ℓ/s.

Thin layers and pockets of peat and organic clay appeared during the excavation. These materials are located randomly and were not detected with the subsoil exploration. The location of those materials is shown in fig 8. Fig 9 shows a detail of the thin peak layers.

CONCLUSIONS

In spite of the previously geotechnical knowledge in the area and the verification soundings, thin layers and pockets of peat and organic clay were undetected. The water flow reduction to a one tenth of the expected one is attributed to the presence of those materials.

Geotechnical explorations in similar areas (randomly geological conditions) must be accomplished with the aid of tools like geophysics and the knowledge of the geological site conditions to prevent hazardous events. Nevertheless even with the execution of a complete program of exploration is possible to find unexpected situations in sites like this one.

REFERENCES

Mooser, F. (1986), "General Geology of the River Balsas Delta". 1985 Earthquakes: Soil Mechanics Case History. SMMS. 15-17

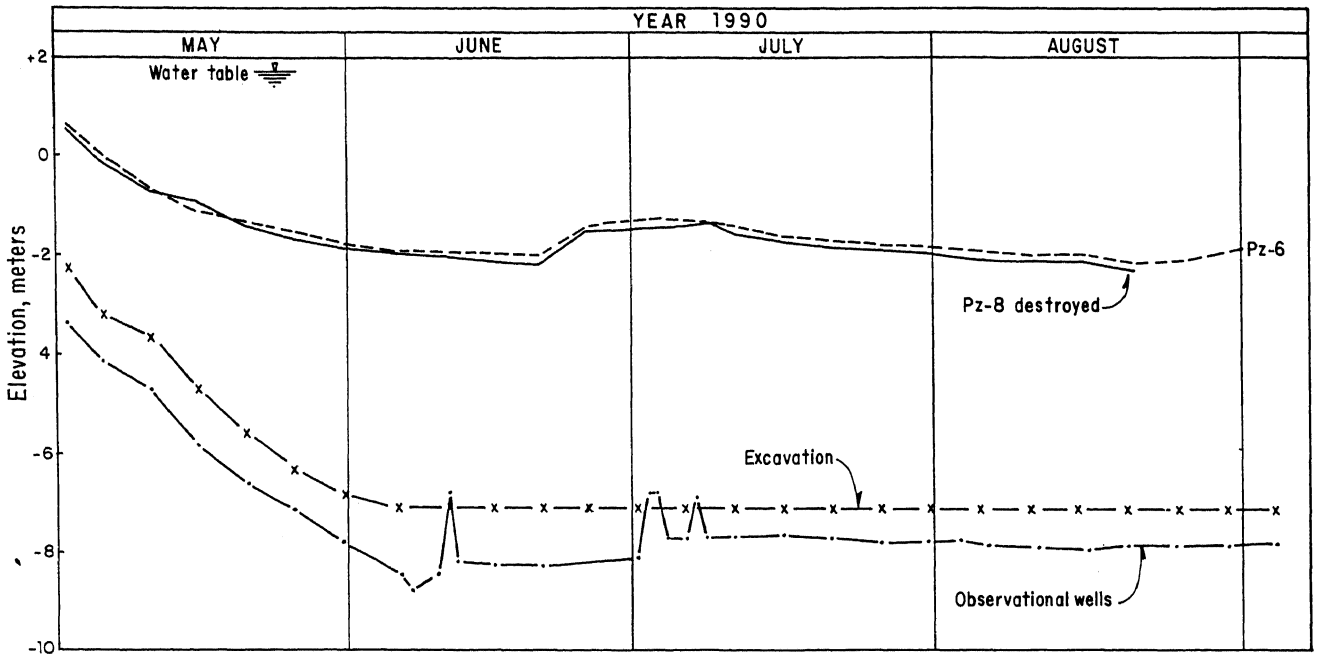


Fig.7 Water levels in piezometers and observational wells

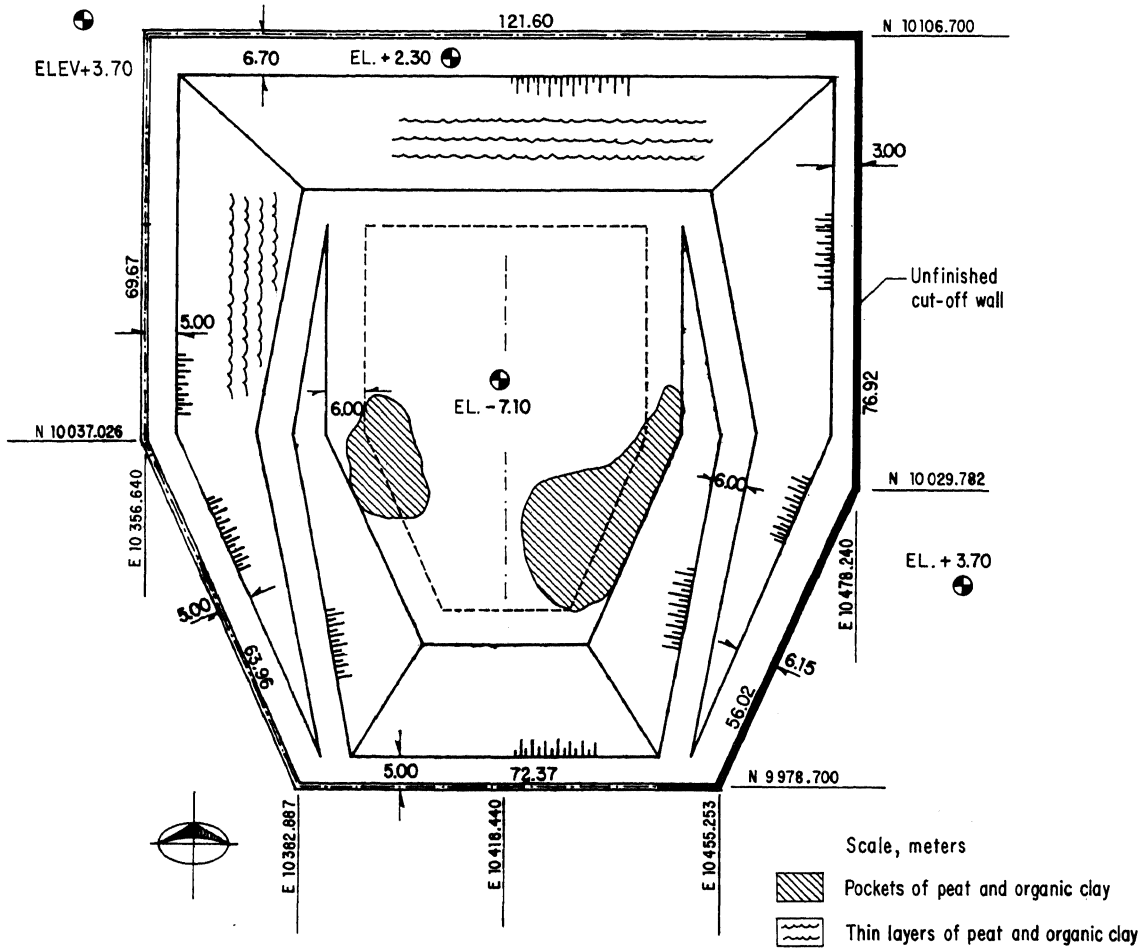


Fig 8 Localization of pockets and thin layers of peat and organic clay

Fig.9 Detail of thin layers of peat and organic clay